7. ALTERNATIVES ANALYSIS

As a new major stationary source being sited in a nonattainment area, AEC prepared an analysis of alternatives to the project. The alternatives analysis demonstrates that the benefits of the currently proposed scope of the project offset and outweigh alternatives to the proposed project. The analysis evaluated alternatives to the current project scope for the following five items:

- Physical location of the proposed project
- Size of the project
- Approach selected to generate electricity
- Type of emissions controls evaluated
- Economic, social, and environmental impacts

This alternatives analysis is required because the proposed location of the source is classified as nonattainment with the NAAQS for O_3. As noted previously, the status of O_3 nonattainment is related to OTR classification and not actual monitored violations of the O_3 NAAQS immediately surrounding the proposed project site. The alternatives analysis focused on the three nonattainment pollutants as they relate to the Project and is consistent with the regulations at §2102.06.

7.1 ALTERNATE PROJECT LOCATIONS

There are many factors that must be considered when selecting a location to construct an electric generating facility. In identifying and screening potential project sites, several key factors and criteria were considered in order to meet Project requirements. These factors included:

1. Proximity to electric transmission lines, fuel pipelines, and water sources (key infrastructure);

2. Land use compatibility (e.g., zoning and compatible neighboring land uses);

3. Adequate site size and topography (providing a minimum of 30 acres that are or can be feasibly adjusted to be relatively flat to accommodate required equipment and support facilities, with adequate buffering to neighboring properties);

4. Site environmental suitability (building acreage, minimum wetland disturbance; avoidance of impacts to protected species; avoidance/minimization of impacts to special protection waters; suitable and stable foundation conditions; etc.); and

5. Real estate availability (i.e., main site landowner willingness to consider sale and potential issues of obtaining easements for supporting off-site infrastructure, such as pipelines).

Applying these factors, AEC identified five candidate sites – Muskingham Township, OH, Ravenswood, WV, Wythe County, VA, Van Buren, MI, and Elizabeth Township, Allegheny County, PA – as meeting the initial screening criteria. Upon further investigation the Muskingham Township, OH it was eliminated from consideration because the real estate price was not economically feasible for the project. The Wythe County, VA and Van Buren, MI sites were removed from consideration based on limited availability of water. The Ravenswood, WV site transmissions costs from the gas pipeline to the site were cost prohibitive and therefore was also removed from consideration.

The proposed location will require reduced infrastructure upgrades relative to the other proposed sites. Specifically, an electrical transmission line less than 1-mile in length will be constructed. Gas supply lateral to the site less than 1-mile in length will be constructed. Access roads to the site will be repaired and upgraded to support construction and operating traffic as well as future public use. Water supply and sewer discharge will be municipal and will require some upgrades to existing system to support the project resulting in improved water pressure/supply reliability to neighboring properties.

7.2 ALTERNATE PROJECT SIZE

AEC has designed the project to produce 639 MW of electric output as a baseload source. The size of the project is based on a consideration and weighing of the regional demand for electricity, the local electrical transmission capacity, natural gas transport capability, combined cycle generation technologies, and the financial return projected for facilities with various sizes of generating capacity.

5,605 MW in 2016. Combined with a projected 0.4% growth in net energy demand, the proposed project will be part of the replacement of existing electric generation and supply of additional demand in the PJM region. PJM is projecting a summer peak load demand of 157,635 MW in 2028 for the region. Thus, there is a need for the proposed project to make-up retiring electric generation and demand growth.

7.3 ALTERNATE APPROACH TO ELECTRIC GENERATION

Invenergy has extensive experience with the development of energy projects related to natural gas as well as renewable energy (e.g., solar and wind). Therefore, Invenergy's experience served as the basis for the analysis of alternate approaches for the generation of electricity. Invenergy considered cost, reliability and environmental impacts as the criteria to perform the comparisons of alternate approaches to electrical generation.

Combined cycle generating stations are a reliable form of electric generation. Whereas electric generation from solar and wind are dependent on meteorological factors and time of day, the combustion of natural gas is a consistent and reliable approach for generating baseload electricity. Additionally, combined cycle plants can manage variability in the demand for electric generation better than other forms (e.g., standard boiler combustion, nuclear). Combustion turbines can react to electric demand in a matter of minutes. Therefore, a combustion turbine represents a greater value to the regional electrical grid than solar or wind generated electricity that is not dispatchable.

If renewable energy were used to generate the same amount of electricity as the proposed Facility, the physical footprint of the site would need to be much larger. If a solar energy farm were placed on the currently proposed footprint of the project site, approximately 2.3 MW of electricity would be generated. If a wind farm was considered in place of the proposed Facility, it would be unlikely that the optimal siting criteria for wind farms would be met. In the eastern U.S., wind farms are sited along mountain ridges or at the end of long open fetches of wind (e.g., along the shorelines of the Great Lakes, a few miles off the continental coastline). In addition, at 3 MW per wind turbine (a high-end output), more than 200 wind turbines would be required to produce an equivalent amount of electric output as the proposed Facility. The closest wind farms are located more than 100 kilometers (62 miles) away from the proposed site include between 30 and 50 wind turbines. The currently proposed site is not compatible with alternative renewable energy generation options, nor are the renewable energy options as capable of producing the required electric output.

The proposed project represents an efficient method to generate electricity especially when compared to older electric generating facilities that are still in operation. The selected equipment will be among the newest of available gas and steam turbine technology. Therefore, the project can be dispatched before older, less efficient electric generating facilities and will thereby reduce the regional level of air pollution including CO_2.

The cost of construction and development of a combined cycle generating station is less than solar and wind farms. The U.S. Energy Information Administration's 2019 annual energy outlook summarized the construction and development costs by region of the country. For the Pennsylvania region, the development and construction costs for solar and wind farms are more than twice the costs for natural gas combined cycle projects. Thus, the use of an alternate approach for the generation of electrical power is not a financially beneficial strategy.

Finally, the use of coal and fuel oil would have greater environmental impacts than natural gas and are not technologies that Invenergy pursues as a developer. Therefore, no consideration was given to these fuels.

7.4 ALTERNATE APPROACH TO CONTROLLING EMISSIONS

Project emissions totals for NO_X and VOC are the only pollutants that trigger NNSR applicability for this facility. NOx emissions trigger NNSR applicability as precursors for O_3 and $PM_{2.5}$ formation while VOC emissions trigger NNSR applicability as a precursor for O_3 formation. AEC has reviewed the approach to controlling NO_X and VOC emissions to assess whether there are alternatives to the proposed emissions controls.

7.4.1 Alternate Controls for NO_X Emissions

As noted in Section 5, LAER for the CT is achieved with the use of efficient combustion design as part of the turbine itself including dry-low NO_X burner technology, good turbine operating practices to limit NO_X emissions, use of natural gas as a fuel, and then the use of SCR as post-combustion emissions control. There are no other proven alternate approaches to control NO_X emissions. Thus, NO_X emissions from the CT are controlled to the best level possible.

The control of NO_X emissions from the Auxiliary Boiler follows a similar approach to that of the CT. Specifically, a combination of efficient boiler design, use of natural gas, good boiler operating practices, and post combustion controls result in the lowest achievable level of NO_X emissions. A literature review determined that there are no other proven alternatives for the control of NO_X emissions, and thus the Auxiliary Boiler is controlled to the best level possible.

Unlike the CT, the Auxiliary Boiler is not being operated for the purpose of generating baseload electric output. The Auxiliary Boiler is being used to support the operation of the ST during start-ups and during other periods as required. This infrequent operating and limited operating schedule means that the Auxiliary Boiler is not a primary source of NO_X emissions at the facility.

The Dewpoint Heater, the Emergency Diesel Engine, and the Fire Pump Engine contribute minor sources of NO_X emissions for the overall Project. The Dewpoint Heater is physically small enough and designed such that post combustion control is not a technically feasible option. Specifically, there is no defined combustion exhaust stream that could be collected and routed for post combustion control. Also, the use of an electric Dewpoint Heater would require a much larger and more expensive piece of equipment. Typical industry standard is to use a gas-fired Dewpoint Heater for an application of this size. A Dewpoint Heater that utilizes waste heat from the CT or the Auxiliary Boiler is also not practical. There are periods when the CT is not operating and thus unable to provide waste heat. Waste heat from the Auxiliary Boiler would require significant capital expense for the installation of a steam line and condensate collection piping because the Auxiliary Boiler and the Dewpoint Heater are located on opposite corners of the site.

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7.4.2 Alternate Controls for VOC Emissions

The CT is equipped with a CO catalyst that also functions to control VOC emissions. In addition to the CO catalyst, the CT is maintained with good operating practices to achieve a LAER limit. The use of a thermal oxidizer could be considered an alternate control of VOC emissions from the CT; however, there are technical and practical limitations that prevent a thermal oxidizer from being a viable alternate control device. First, a thermal oxidizer is not efficient at reducing already low concentrations of VOC, as will be the case with the CT at 1.5 ppm VOC. Second, there will be a very large air flow associated with the CT exhaust (approximately 1,710,000 acfm) and thermal oxidizers are typically designed to handle small exhaust stream flows (e.g., 20,000 acfm). Third, the use of a thermal oxidizer will increase the combustion emissions profile of the facility including NO_X emissions. Therefore, there are no feasible alternative controls to the proposed LAER determination that would be effective at reducing VOC emissions.

VOC emissions from the Auxiliary Boiler are limited through the engineering design of the boiler, the use of good combustion practices, and post combustion control with a CO catalyst, that can also control VOC emissions. As with the CT, the use of a thermal oxidizer as an alternate VOC emissions control device on the Auxiliary Boiler has technical and logistical limitations. The Auxiliary Boiler VOC concentration levels are extremely low at 10 ppm, which will not be efficiently reduced by a thermal oxidizer. The exhaust flow rate for the Auxiliary Boiler is compatible for a thermal oxidizer; however, the use of a thermal oxidizer will generate its own combustion emissions including NO_X emissions thus increasing the emissions profile of the facility. Therefore, a thermal oxidizer is not a feasible alternative to the proposed LAER determination for the Auxiliary Boiler.

Finally, there are no post combustion VOC controls for the Dewpoint Heater, the Emergency Diesel Generator, and the Fire Pump Engine. The size and anticipated usage of each of these three emissions units precludes the use of post combustion controls. The Dewpoint Heater exhaust stream is small and is not collected prior to exhausting. It would be impractical to add post combustion control. The two engines are permitted to operate for a maximum of 100 hours per year and are permitted to emit no more than 0.12 tpy combined VOC. Adding a CO catalyst for

90% control of 0.12 tons would only provide a 210 lb per year reduction in VOC emissions. The use of a CO catalyst as an alternative post combustion control measure would insignificantly affect VOC emissions from the Facility.

7.5 BENEFIT ANALYSIS

The proposed Project will provide multiple benefits to the local and regional public. These benefits will include economic, social, and environmental improvements to the public in Elizabeth Township, Allegheny County, and the Commonwealth of Pennsylvania. A description of the benefits of the project are summarized in the following subsections.

7.5.1 **Economic Benefits**

The proposed Project will provide a significant economic benefit to the local, regional, and statewide community. The construction of the proposed Facility will provide a significant economic boost to the surrounding area through the presence of temporary workers. There will be approximately 16 full-time positions at the Facility, with supporting services and contractors to be required once the Facility is operating. The Facility will also be a taxed facility at the local, county and statewide levels. As part of the air permitting process, AEC will be responsible for paying permitting fees as well as fees to offset emissions of NO_X and VOC. Finally, the generation of electricity via a modern combustion turbine is more efficient than older electric generating units, and thus the proposed Facility will provide an economic benefit indirectly by making the cost of electricity as inexpensive as possible.

7.5.2 **Social Benefits**

AEC will undertake several improvements to the surrounding infrastructure that will benefit the local community. The access road to the site and other surrounding roads will be repaired and upgraded to support construction and operating traffic, as well as future public use. The water supply and discharge for the Facility will require some upgrades to existing municipal water system to support the Project. Improvements to the water pressure and supply reliability to

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neighboring properties will occur. As a future member of the community, AEC anticipates playing an active role by sponsoring community events and local organizations.

7.5.3 Environmental Benefits

The proposed Project will provide environmental benefits since the proposed Project is a well-controlled and efficient approach for the generation of electricity. The environmental benefits will result from the displacement of older, less efficient, higher polluting electric generating facilities. Regional air quality of O_3, NO_2, SO_2, and $PM_{10}/PM_{2.5}$ will improve as higher polluting electric generating facilities are replaced. Although the proposed Project will be a source of local emissions, emissions of regulated NSR pollutants will be minimized by the use of BACT and LAER controls. Also, air quality modeling has been performed to confirm that emissions associated with the proposed Project will have a minimal effect on the surrounding air quality.

7.6 ALTERNATES ANALYSIS CONCLUSIONS

Relocating the proposed project site to an alternate area that is in attainment with the NAAQS for O_3, SO_2, and $PM_{2.5}$ would not result in a significant environmental benefit due to the efficient design of the Project. AEC has incorporated energy efficiency throughout the Facility from combustion devices, to plant operations, to the choice of fuel (i.e., natural gas) to minimize emissions. Emissions in general are controlled and reduced to the best degree possible using BACT. Emissions of NO_X and VOC are precursor pollutants with controls reflecting LAER technology. BACT and LAER for the Project include the use of combustion design, post-combustion control devices, and the application of good operating practices.

In addition, O_3 and $PM_{2.5}$ are regional air pollutants, which means that local sources of O_3 precursor emissions and local sources of direct $PM_{2.5}$ emissions and $PM_{2.5}$ precursor emissions are not likely to contribute to local concentration levels. Specifically:

- NO_X and VOC are the precursor emissions that form O_3 and NO_X, SO_2, and NH_3 are precursor emissions that form $PM_{2.5}$ as a result of atmospheric chemistry that occurs as these pollutants are transported 100 km or more downwind. Thus, emissions sources located outside of Allegheny County are contributors to the local O_3 and $PM_{2.5}$

concentrations. Also, because natural gas is the primary fuel that will be used at AEC, the amount of direct particulate matter that is emitted by AEC will be minimal.

- The amount of SO_2 that AEC will emit is very small since natural gas is the primary fuel that will be used at the facility. Thus, although AEC is located in an SO_2 nonattainment area, the choice of fuels will ensure that SO_2 emissions will be the least possible from a fuel combustion source.

Since the emissions profile from the Facility has been designed to be as minimally impacting as possible, locating the Facility in Allegheny County will have minimal impact on the local air quality related to O_3, $PM_{2.5}$, and SO_2. Air quality modeling and other analyses that have been conducted for the project also support a demonstration of minimal concentrations of O_3, $PM_{2.5}$, and SO_2 resulting from AEC emissions. Considering alternate project sites in place of the proposed site would not significantly improve the surrounding air quality since regional sources located outside of Allegheny County are likely contributors to existing O_3 and $PM_{2.5}$ concentration levels.